COMMUNICATION SCRAMBLER SYSTEM

This invention relates to communication systems and to apparatus for use in such systems.

The invention relates more particularly but not exclusively to communication systems and apparatus for the transmission and reception of speech.

Personal wireless transceivers are now widely used by policeman, for example while on a routine patrol, to maintain contact with their headquarters. However, the value of such communication systems is lessened by their vulnerability to eavesdropping by unauthorised persons.

Scramblers employing various forms of frequency shifting arrangements are known and have been widely employed. However, the time required by an unauthorised person having suitable equipment to unscramble a frequency-shift scrambled message is not very great, so that only a limited security is available. Transmissions scrambled on a truly random basis are undecodable, but the arrangements required are impracticable for widespread, everday use, wherein in any event, only, say, one hour of security is required.

It is therefore an object of the invention to provide an improved communication system and apparatus for use in such a system which allows at least a limited period of privacy or security.

According to a first aspect of the invention, in a communication system for transmitting the intelligence of an input signal, which said input signal is either a speech signal or other signal having components of variable frequency and variable amplitude, a transmitting terminal of the system has means to effect scalar combination of the input signal or of a signal which is derived from the input signal and which contains information as to at least the frequencies of higher frequency components of the input signal with a digital signal having a plurality of possible amplitude levels which occur in a pseudo-random sequence, the signal resulting from the combination or a signal derived therefrom constituting the signal transmitted to a receiving terminal of the system, this transmitted signal carrying information in respect both of the frequencies of said higher frequency components of the input signal (albeit masked by the digital signal) and of the amplitude envelope of the input signal, and the receiving terminal of the system has means to effect scalar combination of the received signal or of a signal derived from the received signal and a digital signal that is similar to that utilised at the transmitting terminal and has the same pseudo-random sequence to recover a first signal carrying information of at least the higher frequency components of the input signal without digital masking, means to recover a second signal carrying information as to the amplitude envelope of the input signal, and means to reconstitute from said first and second signals an output signal which is an intelligible approximation to the input signal.

The signal which is derived from the input signal may be derived by high-pass filtering or differentiation of the input signal.

The signal which is combined with the digital signal may be converted to a signal having a similar or the same plurality of amplitude levels as the digital signal.

The information contained in the transmitted signal in respect of the amplitude envelope may be or be derived from a signal representing the amplitude envelope or its conjugate, and the last-mentioned signal may contain a further digital signal having a plurality of possible amplitude levels which occur in a further pseudo-random sequence, the means to recover the second signal being such as to enable the masking effect of the further digital signal to be counteracted.

According to a second aspect of the invention, in transmitter terminal apparatus for transmitting the intelligence of an input signal, which said input signal is either a speech signal or other signal having components of variable frequency and variable amplitude, the apparatus comprises means to form a digital signal having a plurality of possible amplitude level which occur in pseudo-random sequence, means to effect scalar combination of the digital signal with the input signal or with a signal which is derived from the input signal and which contains information at to at least the frequencies of higher frequency components of the input signal, and means for including in the transmitted signal, which is formed by or derived from the output of the last mentioned means, information in respect of the amplitude envelope of the input signal.

The transmitter terminal apparatus preferably includes means for limiting the bandwidth of the signals to be transmitted to a bandwidth not substantially more than the bandwidth of the input signal.

According to a third aspect of the invention, in receiver terminal apparatus for receiving a transmission of the intelligence of an input signal which said input signal is either a speech signal or other signal having components of variable frequency and variable amplitude, the transmission being formed by or derived from a scalar combination of a digital signal having a plurality of possible amplitude levels which occur in pseudo-random sequence, with the input signal or with a signal derived from the input signal and which contains information as to at least the frequencies of higher frequency components of the input signal, the transmission including information in respect of the amplitude envelope of the input signal, the apparatus comprises means to form a digital signal similar to that utilised in the formation or derivation of the transmission and having the same pseudo-random sequence, means to effect scalar combination of the digital signal with the received signal or a signal derived therefrom to recover a first signal carrying information of at least the higher frequency components of the input signal without digital masking, means to recover a second signal carrying information as to the amplitude envelope of the input signal, and means to reconstitute from said first and second signals an output signal which is an intelligible approximation to the input signal.

The transmitter terminal apparatus may include means for generating a further digital signal having a plurality of possible amplitude levels which occur in a further pseudo-random sequence, and means for combining or superimposing the further digital signal with or on the signal representing the amplitude envelope or its conjugate, the receiver terminal apparatus including means for generating a further digital signal which is similar to the further digital signal utilised in the transmitter terminal apparatus and having the same pseudo-random sequence, means for affecting scalar combination of the further digital signal with said second signal to reconstitute the amplitude envelope or its conjugate.